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**36. Proposed by O. W. ANTHONY, Mexico, Missouri.**

From two points, one on each of the opposite sides of a parallelogram, lines are drawn to the opposite vertices. Through the points of intersection of these lines a line is drawn. Prove that it divides the parallelogram into two equal parts.

**Solution by ALFRED HUME, C. E., D. Sc., Professor of Mathematics in the University of Mississippi, University P. O., Mississippi.**

Let  $OABC$  be the parallelogram,  $O$  the lower left-hand vertex,  $OA$  the base;  $D$  and  $E$  points on  $OA$  and  $CB$  respectively.

If  $OA=b$ ,  $OC=a$ ,  $OD=n$ ,  $CE=m$ , then, taking  $OA$  as the  $X$ -axis and  $OC$  as the  $Y$ -axis, the points  $O, A, B, C, D$ , and  $E$  will be given by the co-ordinates  $(0,0), (b,0), (b,a), (0,a), (n,0)$ , and  $(m,a)$  respectively.

It follows that the equation of  $OE$  is  $\frac{y}{a} = \frac{x}{m}$ ; . . . . . (1).

The equation of  $CD$  is  $\frac{y}{a} + \frac{x}{n} = 1$ ; . . . . . (2).

The equation of  $BD$  is  $y = \frac{-a}{n-b}(x-n)$ . . . . . (3).

The equation of  $EA$  is  $y = \frac{-a}{b-m}(x-b)$ . . . . . (4).

From (1) and (2) the intersection of  $OE$  and  $CD$  is

$$\left( \frac{mn}{m+n}, \frac{an}{m+n} \right) \text{ which denote by } (x', y').$$

From (3) and (4) the intersection of  $BD$  and  $EA$  is

$$\left( \frac{b^2-mn}{2b-m-n}, \frac{-a(n-b)}{2b-m-n} \right) \text{ which denote by } (x'', y'').$$

The equation of the line passing through these points of intersection is  
 $y - y' = \frac{y'' - y'}{x'' - x'}(x - x')$ . . . . . (5).

If the center of the parallelogram is on this line its co-ordinates,  $\left(\frac{b}{2}, \frac{a}{2}\right)$ , will satisfy (5).

Substituting and reducing,  $\frac{1}{2} - \frac{n}{m+n} = \frac{m-n}{2(m+n)}$ , or (5) is satisfied.

Since every line which passes through the center of a parallelogram divides it into two equal parts, the proposition is established.

## PROBLEMS.

**39. Proposed by J. K. ELLWOOD, Principal of Colfax Schools, Pittsburg, Pennsylvania**

If on the three sides of any plane triangle equilateral triangles be described, the lines joining the centres of these equilateral triangles form an equilateral triangle.

**40. Proposed by J. C. CORBIN, Pine Bluff, Arkansas.**

If  $R$ ,  $r$ ,  $r_1$ ,  $r_2$ , and  $r_3$  be, respectively, the radii of the circumscribed, inscribed, and escribed circles of a  $\triangle$ , prove  $r_1 + r_2 + r_3 - r = 4R$ .

41. Proposed by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in New Windsor College, New Windsor, Maryland.

Find the length ( $x$ ) of a rectangular parallelopiped  $b=5$  ft. and  $h=3$  ft., which can be *diagonally inscribed* in a similar parallelopiped  $L=83$  ft.,  $B=64$  ft., and  $H=50$  ft.



## CALCULUS.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

### SOLUTIONS OF PROBLEMS.

26. Proposed by Professor J. F. W. SCHEFFER, M. A., Hagerstown, Maryland.

According to Bessel, the ratio of the squares of the polar diameter of the earth to that of the equatorial diameter, is .9933254. Find what *latitude* the angle made by a body falling to the earth, with a perpendicular to the surface, is greatest. Find, also, this maximum angle.

Solution by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy in New Windsor College, New Windsor, Maryland.

Let  $\phi$ =the required geographical latitude, and  $\phi'$ =the geocentric latitude of the same place; then Chauvenet's *Spherical and Practical Astronomy*, Vol. I., p. 98, we deduce  $\phi' = \tan^{-1}[(b^2/a^2)\tan\phi] = \tan^{-1}[(1-e^2)\tan\phi]$ .

$$\therefore (\phi - \phi') = \phi - \tan^{-1}[(1-e^2)\tan\phi], = \text{a Maximum.}$$

$$\therefore \frac{d(\phi - \phi')}{d\phi} = 1 - \frac{(1-e^2)(1+\tan^2\phi)}{1+(1+e^2)^2\tan^2\phi} = 0.$$

$$\therefore \phi = \tan^{-1} \left[ \sqrt{\left( \frac{1}{1-e^2} \right)} \right] = \tan^{-1}(1.0033541) = 45^\circ 5' 45''.32,$$

$$\text{and } \phi' = \tan^{-1}(0.9966571) = 44^\circ 54' 14''.67.$$

Hence  $(\phi - \phi') = 11' 30''.65$ ; and this result is found in the already-named Manual of Astronomy, Vol. II.; third Table, p. 577.

II. Solution by G. B. M. ZERR, A. M., Principal of High School, Staunton, Virginia.

Not taking into account the eastward deviation due to the rotation of the earth we can proceed as follows:

Let  $HEC$  be the direction the body falls,  $FEG$  the perpendicular to the earth's surface at  $E$ ,  $DEK$  the tangent to the meridian at  $E$ ,  $CA=a$ ,